PORTLAND HARBOR RI/FS

APPENDIX P
FLOOD RISE EVALUATION
FEASIBILITY STUDY

June 2016

This page left blank intentionally.

TABLE OF CONTENTS

LIST OF TABLES

This page left blank intentionally.

P1. FLOOD RISE EVALUATION

An assessment of impacts on water surface elevation during high flow events was conducted to evaluate compliance with ARARs. Balancing the amount of material dredged and placed in the river was considered during the development and evaluation alternatives to minimize the potential for unacceptable flood rise following remedy implementation and comply with federal and state floodplain management ARARs.

The Executive Order for Floodplain Management (Executive Order 11988) requires federal agencies carrying out their responsibilities to take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains. Agencies are to evaluate the potential effects of any actions they may take in a floodplain to ensure that their planning programs and budget requests reflect consideration of flood hazards and floodplain management, including the restoration and preservation of such land areas as natural, undeveloped floodplains. The order emphasizes the importance of evaluating alternatives to avoid impacts and incompatible development in floodplains, minimizing the potential harm to floodplains if the only practicable alternative requires siting an action in a floodplain, and providing early and adequate opportunities for public review of plans and proposals involving actions in floodplains. Under this concept, the special flood hazard area (commonly referred to as the 100-year flood plain) is divided into floodway and floodway fringe. If a proposed channel modification affects the floodway such that the river stage is increased for the base flood condition, such a conveyance reduction would constitute a floodway encroachment. If a proposed floodway action such as construction of a sediment cap results in a regulatory floodway encroachment, then either:

- The encroachment must be mitigated (offset) such that there is no net increase in river stage; or

- The floodway is realigned or adjusted in consultation with the requisite authorities.

A simplified evaluation was conducted for each alternative by comparing estimated volumes of capping and dredging within each sediment decision unit (SDU) and throughout the site. This evaluation did not consider uncertainties associated with changes in waterway use, changes in management of reservoirs within the Willamette River watershed and the effects of global climate change that may result in changes to the flood rise elevation. Uncertainties associated with potential channel deepening were also not considered. In addition, this evaluation is specific to DMM Scenario 2 because it does not consider construction of an in-water CDF. While a CDF could impact flood rise on a local scale, it would be designed to minimize potential impacts, and it is excluded from this simplified evaluation.

Although proposed riverbank excavations assume removal of material prior to the placement of caps, this information was not included in the flood rise evaluation due the uncertainties associated with the extent of contamination in the riverbanks. Volumes of material to be removed during dredging were calculated on an SDU and site-wide basis. Estimated volumes of materials placed are based on the total volume of the following:

- Sand
- Armor material
- AquaGate
- AquaBlok™
- Beach mix
- Organoclay

Quantities of fill materials and dredged volumes are summarized in **Tables P-1** through **P-15** (excluding construction of the CDF at Terminal 4). Evaluated on a Site-wide scale, the volume of fill for each alternative is less than the total volume removed, resulting in a net cut volume. Evaluated on a SDU basis, the volume of fill for each alternative is less than the total volume removed for the majority of the SDUs. Exceptions include SDUs RM5.5E, RM3.9E and RM6.5E. In additional the volume of material removed relative to the volume of fill placed increases as the size of the remedial footprint increases. While this is not entirely balanced with respect to dredging and placement of fill material, it does indicate that there is no net increase in channel depth, minimizing potential increase to flood rise levels due to the application of technology assignments, fulfilling the requirements for protection of human health and the environment and compliance with ARARs with respect to flood rise. In addition, the uncertainty of flood rise impacts on a site-wide scale is lessened with increasing net dredged volumes.

Tables

This page left blank intentionally.

Table P-1
Estimation of Net Volume of Material Removed - NoSDU
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	15,018	39,901	95,679	1,035,348	2,604,123	6,035
Fill Material Volumes							
Sand	(cy)	12,629	30,735	37,314	179,461	447,905	4,658
Armor	(cy)	3,259	6,330	7,270	16,656	50,837	915
AquaGate	(cy)	942	2,476	2,046	4,215	13,386	1,154
AquaBlok™	(cy)	0	0	34	34	34	34
Beach mix	(cy)	1,230	2,778	3,413	5,678	11,172	685
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	18,060	42,318	50,078	206,043	523,334	7,447
Net volume removed	(cy)	-3,042	-2,418	45,601	829,305	2,080,789	-1,412

Table P-2
Estimation of Net Volume of Material Removed - SDU RM2E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	16,028	27,584	49,206	128,929	173,718	49,206
Fill Material Volumes							
Sand	(cy)	9,367	17,649	29,640	60,703	76,510	29,640
Armor	(cy)	2,307	4,204	6,830	14,930	19,752	6,830
AquaGate	(cy)	4,323	6,010	7,615	9,701	10,644	7,615
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	1,548	2,185	3,207	4,465	5,206	3,207
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	17,545	30,048	47,293	89,799	112,111	47,293
Net volume removed	(cy)	-1,517	-2,463	1,913	39,130	61,607	1,913

Table P-3
Estimation of Net Volume of Material Removed - SDU RM3.5E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	16,150	24,333	48,142	80,173	116,631	48,142
Fill Material Volumes							
Sand	(cy)	5,134	12,397	25,252	42,435	59,022	25,252
Armor	(cy)	504	1,930	5,287	9,631	13,343	5,287
AquaGate	(cy)	2,365	3,397	4,416	7,808	9,210	4,416
AquaBlok™	(cy)	26	64	236	236	236	236
Beach mix	(cy)	56	889	1,724	1,952	2,102	1,724
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	8,083	18,676	36,915	62,062	83,913	36,915
Net volume removed	(cy)	8,067	5,657	11,227	18,110	32,717	11,227

Table P-4
Estimation of Net Volume of Material Removed - SDU RM4.5E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	1,554	43,167	75,097	178,990	254,571	75,097
Fill Material Volumes							
Sand	(cy)	288	8,582	18,147	48,616	73,729	18,147
Armor	(cy)	11	530	1,080	2,869	6,269	1,080
AquaGate	(cy)	108	2,116	2,992	3,141	3,381	2,992
AquaBlok™	(cy)	0	0	6	6	6	6
Beach mix	(cy)	2	407	980	2,376	2,956	980
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	409	11,636	23,205	57,009	86,340	23,205
Net volume removed	(cy)	1,145	31,531	51,892	121,982	168,231	51,892

Table P-5
Estimation of Net Volume of Material Removed - SDU RM5.5E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	0	0	4,340	35,004	81,389	35,004
Fill Material Volumes							
Sand	(cy)	29	29	2,094	28,992	52,073	28,992
Armor	(cy)	0	0	359	7,256	11,770	7,256
AquaGate	(cy)	27	27	201	201	225	201
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	0	0	257	1,985	3,374	1,985
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	56	56	2,912	38,434	67,442	38,434
Net volume removed	(cy)	-56	-56	1,428	-3,430	13,947	-3,430

Table P-6
Estimation of Net Volume of Material Removed - SDU RM6.5E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	4,038	15,844	17,974	46,334	61,951	6,165
Fill Material Volumes							
Sand	(cy)	19,773	48,495	51,668	77,007	98,231	25,485
Armor	(cy)	2,369	6,580	7,509	14,502	21,672	2,854
AquaGate	(cy)	3,843	4,035	3,884	4,681	4,792	4,350
AquaBlok™	(cy)	40	40	40	40	40	40
Beach mix	(cy)	567	1,870	1,870	3,194	3,480	707
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	26,592	61,021	64,972	99,425	128,215	33,436
Net volume removed	(cy)	-22,554	-45,176	-46,998	-53,091	-66,265	-27,271

Table P-7
Estimation of Net Volume of Material Removed - SDU SwanIs
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	32,377	146,062	523,242	1,089,075	1,297,139	523,242
Fill Material Volumes							
Sand	(cy)	169,800	165,744	182,558	191,923	198,988	182,558
Armor	(cy)	493	3,080	4,635	7,980	10,761	4,635
AquaGate	(cy)	7,759	16,639	1,958	1,958	1,958	1,958
AquaBlok™	(cy)	0	686	1,743	1,743	1,743	1,743
Beach mix	(cy)	4	791	1,311	2,117	2,813	1,311
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	178,055	186,940	192,205	205,720	216,263	192,205
Net volume removed	(cy)	-145,678	-40,878	331,037	883,355	1,080,877	331,037

Table P-8
Estimation of Net Volume of Material Removed - SDU RM11E
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	18,944	33,687	53,592	82,501	95,574	53,592
Fill Material Volumes							
Sand	(cy)	6,521	10,840	18,950	34,902	44,811	18,950
Armor	(cy)	1,048	1,783	2,696	7,126	10,715	2,696
AquaGate	(cy)	1,865	2,379	2,143	2,800	3,566	2,143
AquaBlok™	(cy)	349	627	856	856	856	856
Beach mix	(cy)	426	533	1,489	1,933	2,041	1,489
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	10,208	16,162	26,135	47,618	61,989	26,135
Net volume removed	(cy)	8,736	17,525	27,457	34,883	33,585	27,457

Table P-9
Estimation of Net Volume of Material Removed - SDU RM3.9W
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	0	0	543	6,744	39,935	543
TOTAL CUT	(cy)	0	0	543	6,744	39,935	543
Sand	(cy)	0	0	279	6,972	36,353	279
Armor	(cy)	0	0	48	2,741	11,552	48
AquaGate	(cy)	0	0	20	1,034	2,980	20
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	0	0	33	607	4,589	33
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	0	0	380	11,355	55,473	380
Net volume removed	(cy)	0	0	163	-4,611	-15,538	163

Table P-10
Estimation of Net Volume of Material Removed - SDU RM5W
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	749	11,565	16,435	38,681	66,324	16,435
Fill Material Volumes							
Sand	(cy)	415	7,177	11,141	21,619	37,066	11,141
Armor	(cy)	78	1,381	2,574	5,522	9,530	2,574
AquaGate	(cy)	16	538	1,241	2,883	3,945	1,241
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	135	787	1,167	2,565	3,815	1,167
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	644	9,883	16,122	32,589	54,356	16,122
Net volume removed	(cy)	105	1,683	312	6,092	11,969	312

Table P-11
Estimation of Net Volume of Material Removed - SDU RM6Nav
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	111,557	270,111	390,715	767,030	1,238,472	118,839
Fill Material Volumes							
Sand	(cy)	42,492	77,638	102,067	152,022	179,361	43,954
Armor	(cy)	0	0	0	0	0	0
AquaGate	(cy)	996	5,224	5,472	9,187	12,253	2,377
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	0	0	0	0	0	0
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	43,488	82,861	107,539	161,209	191,614	46,331
Net volume removed	(cy)	68,069	187,250	283,176	605,821	1,046,858	72,508

Table P-12
Estimation of Net Volume of Material Removed - SDU RM6W
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	240,863	309,569	335,467	410,081	445,667	309,569
TOTAL CUT	(cy)	240,863	309,569	335,467	410,081	445,667	309,569
Sand	(cy)	39,705	44,486	48,131	61,436	77,954	42,634
Armor	(cy)	3,769	5,591	6,631	11,991	16,583	5,591
AquaGate	(cy)	12,215	14,055	15,279	17,426	18,295	14,055
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	2,765	2,880	2,919	3,161	4,307	2,880
Organoclay	(cy)	109	109	109	109	109	109
Total fill	(cy)	58,562	67,120	73,070	94,123	117,249	65,268
Net volume removed	(cy)	182,301	242,448	262,397	315,957	328,418	244,301

Table P-13
Estimation of Net Volume of Material Removed - SDU RM7W
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	100,882	124,108	170,255	260,430	436,261	260,430
Fill Material Volumes							
Sand	(cy)	36,256	51,194	68,538	93,690	132,000	91,596
Armor	(cy)	10,604	14,641	17,696	23,893	32,344	23,893
AquaGate	(cy)	12,053	15,912	20,571	28,690	38,704	28,690
AquaBlok™	(cy)	0	0	0	0	0	0
Beach mix	(cy)	3,500	5,330	8,039	10,472	12,722	10,472
Organoclay	(cy)	123	123	123	123	123	123
Total fill	(cy)	62,536	87,199	114,968	156,868	215,894	154,774
Net volume removed	(cy)	38,346	36,909	55,288	103,562	220,367	105,656

Table P-14
Estimation of Net Volume of Material Removed - SDU RM9W
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	18,720	62,113	147,448	303,253	345,900	147,448
TOTAL CUT	(cy)	18,720	62,113	147,448	303,253	345,900	147,448
Sand	(cy)	10,973	23,325	71,633	130,369	149,356	71,633
Armor	(cy)	3,515	5,719	15,063	25,237	28,881	15,063
AquaGate	(cy)	3,922	5,745	9,592	12,301	13,316	9,592
AquaBlok™	(cy)	1,220	2,272	2,765	2,765	2,765	2,765
Beach mix	(cy)	1,444	3,367	7,341	10,109	10,489	7,341
Organoclay	(cy)	0	0	0	0	0	0
Total fill	(cy)	21,074	40,427	106,393	180,782	204,807	106,393
Net volume removed	(cy)	-2,354	21,686	41,055	122,471	141,093	41,055

Table P-15
Estimation of Net Volume of Material Removed - Site-Wide
Portland Harbor Superfund Site
Portland, Oregon

	Units	Alt. B	Alt. D	Alt. E	Alt. F	Alt. G	Alt. I
Dredge Volume	(cy)	576,880	1,108,045	1,928,135	4,462,572	7,257,654	1,649,747
Fill Material Volumes							
Sand	(cy)	353,379	498,290	667,414	1,130,149	1,663,359	594,920
Armor	(cy)	27,956	51,767	77,680	150,331	244,009	78,720
AquaGate	(cy)	50,434	78,553	77,432	106,027	136,654	80,806
AquaBlok™	(cy)	1,634	3,689	5,680	5,680	5,680	5,680
Beach mix	(cy)	11,676	21,817	33,750	50,615	69,065	33,981
Organoclay	(cy)	232	232	232	232	232	232
Total fill	(cy)	445,311	654,347	862,188	1,443,035	2,118,999	794,340
Net volume removed	(cy)	131,569	453,697	1,065,947	3,019,537	5,138,654	855,407